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On Gondwana and the Haliotids, a Hypothesis

by

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For some time, the writer has been confronted with a rather perplexing problem of allopatric distribution in the Haliotidae. There are a number of cases in which obviously closely related species, with rather limited ranges, are separated by both ocean basins and continental land masses. In the normal study of the phylogeny of such a group, one usually has available fossil material. However, in the haliotids such fossils are rare. This is probably due to the fact that the ecological biome, shallow waters on a rock or coral substrate, does not meet the general requirements for sedimentary deposits. The few shells that are washed ashore onto a sandy beach are usually broken into fragments or are too small. With so little fossil material available, we must postulate much that we are unable to prove at this time. However, there are certain features, even with the inadequate material available, that give us a very strong indication of the phylogeny. The earliest example examined is a specimen of Haliotis lomaensis Anderson, from the Cretaceous of Point Loma, California, and now in the California Academy of Sciences. This tiny shell exhibits features that leave no doubt as to the identification, and indicate that the basic characteristics of the haliotids were well and firmly established at that time. Later fossils bear this out remarkably well and may be much closer than the present species differences indicate. In other words, we are dealing with a family that was well established in the late Mesozoic, and possibly at an earlier age. With such a lack of fossil material, we must use the ones that we do have, plus the geological history, and the present distributions as we know them.

Dr. A. Myra Keen, of Stanford University, kindly made available to the writer certain publications dealing with the theory of Gondwana or Gondwanaland. As the writer is neither a geologist nor a paleontologist, much of the technical information was not fully understood. However, the general idea of land bridges was clear. Gondwana is the name that was applied to a possible land mass, large or small, that included portions of present-day South America, Africa, and south Atlantic Ocean. Some authors also included areas in the Indian Ocean as part of Gondwana, but others separated this portion into another region, Lemuria. Some considered Gondwana to be a massive land area, while others thought that the connections were rather narrow, perhaps in the nature of an isthmus. No distinct geological time, excepting Paleozoic, was given for the original formation of this area, and the submergence was referred to by some as taking place in the Mesozoic. Others, utilizing the differences noted in fossil reptiles and amphibians, placed the sinking in the Paleozoic, as these animals would have needed land areas to move about.

Some rather interesting facts based upon this theory and our knowledge of present distribution of certain haliotids were noted. There is in the Galapagos Islands a tiny species, Haliotis dalli Henderson, which is obviously closely related to H. parva Linnaeus, of South Africa. Here we may find not only the width of the south Atlantic Ocean, but the continent of South America with the high Andes forming a barrier. No intermediate specimens are known, and except for the single beach specimen taken at Rio de Janeiro, no other haliotids have been found in South America. Incidentally, the single shell referred to above is described and figured as being quite distinct from either H. parva or H. dalli, and little is known about the species. From the geologists we learn about a remarkable bit of information that may pertain to this situation. In the vicinity of Port Elizabeth, South Africa, there is a Cretaceous formation known as the Uitenhage Series. A similar formation of like age, and also indicating shallow waters, is found in Argentina, Bolivia, and Chile. The fossils of these deposits are remarkable for their similarities.

The Canary Islands, which have a rock that is continental in character, are inhabited by a small species, Haliotis coccinea Reeve. Across Africa and the Indian Ocean we find a very close relative, the H. squamata Reeve inhabiting the shores of the Timore Sea. Here, we find a number of species that are probably closely related and which have sympatric ranges, but the closely allied H. coccinea is isolated with no similar species being found elsewhere excepting Asiatic waters.

South along the European Coast and the west coast of Africa, we find the Linnaean Haliotis tuberculata, with ranges south to the Gold Coast. In Natal and portions of South Africa on the Indian Ocean, we find the small H. speciosa Reeve, which has a similar shell. Here the main mass of the African continent forms a barrier.

We might consider other species, such as the obvious relationship of Haliotis quecketti Smith of Natal and H. brazieri Angas from New South Wales. Perhaps the classical example is the discovery of H. sanguinea Hanley living in West Australia, with no intermediate localities known other than the basic range in South Africa. The remarkable facts about this distribution are the limited ranges of these closely allied species, and the lack of intermediate stations.

The three theories dealing with continental areas may be referred to as "Continental Stability", "Continental Drift", and "Land Bridges". The first assumes that the ocean basins and continents have always been more or less as they are today. It is impossible for the writer to accept this theory, for when one is standing on a marine deposit that is now elevated six thousand feet above the present sea level, there is nothing to indicate stability. This is especially true when one learns that both prior to and after this marine submergence there were periods when the region was above the sea. The idea of the breaking apart of a major land mass and the drifting of the continents on the magma to their present position is likewise difficult to accept because of these same fossil deposits and their sequence. The very formations found in Arizona and Utah, marine, freshwater, land, more marine, and so on, lend the theory of land bridges, submergences and elevations, what appear to be factual data. We also know that certain connecting links of the not too distant past are lost. Probably the most noted is that land connection between Siberia and Alaska which is now beneath the sea. Panama appears to have been below and above the sea a number of times. Thus it is not difficult to picture major elevations and submergences in the geological past.

In view of this information it appears reasonable to assume that this might have happened. Sometime in the Paleozoic there existed perhaps a continental mass, perhaps an isthmus, perhaps a series of islands in a shallow sea that extended around the southern hemisphere. Such a region would furnish the shallow water with coral or rock for the haliotids. As geological changes altered the situation, certain portions of the range were separated by non-habitable regions. This left isolated populations which survived, perhaps in the original stage, perhaps altered somewhat. Perhaps we have several basic species represented in this situation, although the majority appear to belong to the genus or subgenus Padollus. Perhaps we have had several such distributions and separations in the past geological time.

The argument has been advanced that such distributions are the result of planktonic drift. If this is true, where are the intermediate stations? And also, if this is true, then the free-swimming stage must last far longer than is now known, since the distances are measured in the thousands of miles, and often against strong currents.

In conclusion, let us briefly review the known facts that we have concerning both Gondwana and the Haliotidae. Gondwana is supposed to have occupied portions of present-day South America and Africa, as well as the south Atlantic Ocean. This area was presumed to have submerged or was submerging during the late Paleozoic or Mesozoic. Such major geological changes take years to complete. This theory is based upon similarities of plant and invertebrate fossils and differences in terrestial vertebrate fossils. We may trace the haliotids back in geological history to the Cretaceous. We find certain species, that are obviously related to each other, living in isolated areas of what would have been Gondwanaland. Thus, if we accept the theory of Gondwana, it would be logical to assume that these species, or a common ancestor species, lived along the shores of this lost region. As the region sank into the depths, these isolated populations remained, and today represent relics of that past distribution.

Or perhaps this is all in error, and we are actually confronted with some remarkable cases of parallel evolution.

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Gastropods from Clipperton Island

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This is the third contribution in a series of papers (see: The Veliger, vol. 1, no. 4, pp. 32-34; vol. 2, no. 4, pp. 94-95, pl. 22) dealing with the Indo-Pacific West American molluscan fauna of Clipperton Island, an isolated coral atoll in the eastern Pacific, about 670 miles southwest of Acapulco, Mexico.

Specimens on which this paper is primarily based were collected by the junior author with the assistance of other personnel participating in 1956 and 1958 Clipperton Island investigations by the Scripps Institution of Oceanography. Collections were taken from the beach, from the reef flat, and (by SCUBA diving) from off the edge of the reef flat to water depths of about 40 meters (130 feet). Conrad Limbaugh of the Scripps Institution of Oceanography, recently lost in a tragic diving accident, collected specimens